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(54) A tube profiling tool

(57) A tube profiling tool, comprising means 1 for securing the profiling tool relative to a workpiece, a cutting tool support 2 adapted to receive at least one cutting tool 6,7,8, means whereby the cutting tool support and the workpiece may be rotated relative to one another about a predetermined axis, and means whereby the cutting tool support and the workpiece may be moved relative to one another, parallel to said axis. The or each cutting tool received by the cutting tool support is secured in position relative to the cutting tool support by an intermediate member 17 which is detachably securable to the cutting tool support, the dimensions of the intermediate member determining the position of the cutting tool relative to the said axis.

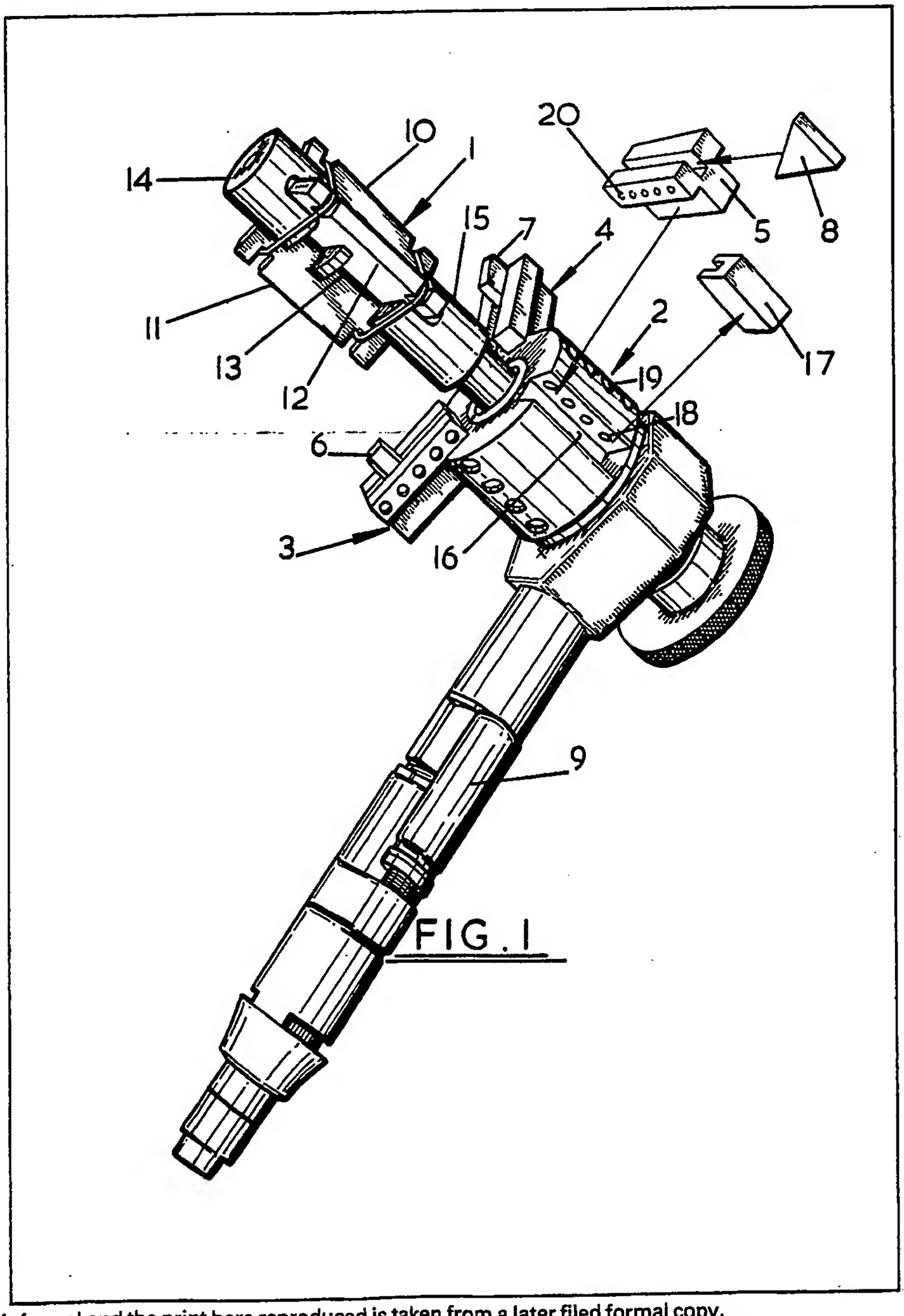

FIG. 1

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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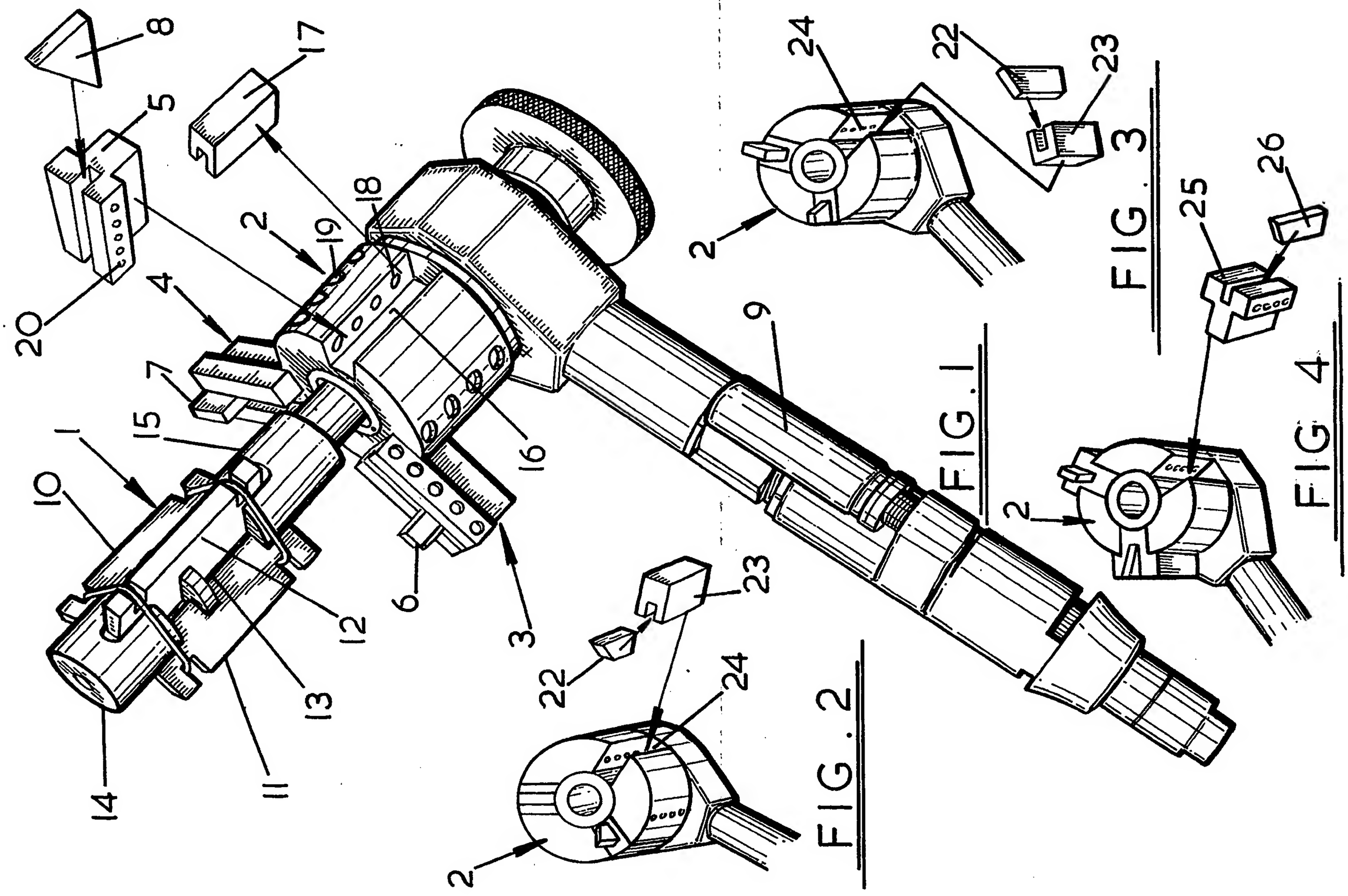

FIG. 1

FIG. 2

FIG. 3

FIG. 4

SPECIFICATION

A tube profiling tool

The present invention relates to a tube profiling tool.

In many industries, for example, the petrochemical, nuclear, power generating, and boiler manufacturing industries, in-situ precision profiling of tubes is necessary.

It has been known to profile tubes using grinding techniques, but such techniques can give rise to safety hazards in some industries, and in addition do not give the high tolerances in the profiled tube now required. As a result precision profiling of tubes is now done using cutting techniques.

There are a great number of different tube profiles which may be required, and as a result tube profiling tools must be able to cut for example grooves, faces and refaces, chamfers, bevels, bores and lands.

Conventional tube profiling cutting tools can be adapted to perform any of the above-mentioned cutting operations, but suffer from a number of disadvantages. Conventional tube profiling tools are large and cumbersome and are therefore not ideally suited to use in-situ where, for example, it is frequently necessary to profile a tube fixed in position and to which the only access is through a confined space. In addition, conventional profiling tools cannot be simply and easily adapted from one cutting operation and/or tube diameter to another. Finally, conventional profiling tools cannot easily perform more than one cutting operation at a time with any degree of simplicity.

It is an object of the present invention to provide a tube profiling tool in which the above-mentioned problems are obviated or mitigated.

According to the present invention there is provided a tube profiling tool, comprising means for securing the profiling tool relative to a workpiece, a cutting tool support adapted to receive at least one cutting tool, means whereby the cutting tool support and the workpiece may be rotated relative to one another about a predetermined axis, and means whereby the cutting tool support and the workpiece may be moved relative to one another, parallel to said axis, characterised in that the or each cutting tool received by the cutting tool support is secured in position relative to the cutting tool support by an intermediate member which is detachably securable to the cutting tool support, the dimensions of the intermediate member determining the position of the cutting tool relative to the said axis.

Preferably the cutting tool support comprises a drive head to which the or each intermediate member is detachably secured.

Preferably the drive head is pneumatically driven.

The or each intermediate member is preferably detachably secured in a slot in the drive head, of which there are preferably three.

Each intermediate member comprises a slot in which a cutting tool may be engaged.

The intermediate members preferably comprise U and T shaped members. The U shaped members are positioned in the drive head slots so that the cutting in either a U or an inverted U mode to vary the distance of a cutting tool engaged therein from the said axis by the thickness of the base of the U shaped member. The T shaped members may be positioned in the drive head slots so that the cutting tool slots extend parallel to or at right angles to the drive head slot. In the right angle mode the position of a cutting tool relative to the said axis may be varied according to the length of the cutting tool slot. Preferably in the parallel mode, the distance of the cutting tool from the said axis is greater than the maximum distance of a cutting tool from the said axis in a U member.

Preferably a plurality of T members are provided of different cutting tool slot length.

In the right angle mode a U member may be positioned in the drive head slot beneath the T member to provide additional support.

It will be appreciated that any combination of intermediate member modes may be used together. It will also be appreciated that a plurality of distinct cutting operations may be carried out simultaneously. Preferably the securing means comprises a collet chuck. A plurality of collet chucks may be provided with each profiling tool to fit respective ranges of workpiece internal diameter.

Preferably the means whereby the cutting tool support and the workpiece are moved relative to one another, parallel to the said axis comprises a screw.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawing, in which :

Figure 1 shows a tube profiling tool, provided with T members in the right angle mode, embodying the present invention; and

Figures 2 to *4* show the head of the tool of Figure 1 adapted to a variety of further cutting modes.

Referring to Figure 1 the tube profiling tool comprises a workpiece securing and self centering assembly 1, a head 2 upon which are mounted three T members 3, 4 and 5 in their vertical position and each supporting a respective cutting tool 6, 7 and 8, and a compressed air supply line 9 to drive the head 2 when a workpiece is to be cut.

The assembly 1 is a conventional collet chuck comprising three blades 10, 11 and 12 evenly spaced around a shaft 13. At each end of the blades 10, 11 and 12 there is positioned a boss 14 and 15 respectively, each having three slots, into which the ends of the blades 10, 11 and 12 engage. The boss 14 is movable along the shaft 13 by means of a screw (not shown). The floor of each slot in the bosses 14 and 15 is inclined and thus forms a wedge, so that by moving the boss 14 towards boss 15 the blades 10, 11 and 12 are forced outwards from the shaft 13, thus expanding the collet chuck. By positioning the collet chuck in the bore of a tube and then expanding it, the tool is clamped to the tube and automatically centred.

The maximum distance which the blades 10, 11 and 12 can move from the shaft 13 in the embodiment shown in approximately ⅜ of an inch and therefore in order to cope with a number of different internal diameter workpieces a number of interchangeable collet chucks are provided with each

The blades 10, 11 and 12 are manufactured to be compatible with the workpiece material.

The head 2 comprises three slots into which cutting tool holding members are secured. Only one such slot 16 is shown and will be described in Figure 1.

In Figure 1 the cutting tool holding members shown are T members 3, 4 and 5 in the right angle mode. In order to provide support for the T member 5 in the slot 16 in the head 2, and U member 17, which is described further hereinbelow, may be used to fill the slot 16 below the T member 5.

The T member 5 and U member 17 are secured in position in the head 2 by means of grub screws the ends 18 of which can be seen in slot 16. Access to the heads of the grub screws is by means of screw holes 19.

The cutting tool 8 is secured in the T member 5 by means of grubs screws, access to which is by means of screw holes 20. The cutting tool 8 may be secured in any position along the length of the T member 5 by tightening the appropriate grub screws. In this way the position of the cutting tool 8 relative to the axis of a workpiece on the collet chuck may be easily varied.

By using three different tools 6, 7 and 8 in respective T members 3, 4 and 5 and/or by mounting each cutting tool 6, 7 and 8 at a different distance from the centre of the head 2, three separate cutting operations may be carried out at the same time.

In order to ensure that the maximum cutting size of the head 2 is kept to a minimum from one application to another each tube profiling tool may be provided with a number of sets of T members, the length of each set of T members increasing in steps so as to allow the smallest size of T member suitable for a particular application to be selected.

The head 2 is pneumatically driven from a compressed air supply through the supply line 3. The use of a pneumatic drive enables the tool to be safely used in almost any environment.

The profiling tool is gear driven throughout, halving the cutting loads carried on preloaded linear rotary olite bearings. The thread on the gearing gives ten speed options.

The head 2 is moved relative to a workpiece clamped on the collet chuck by means of a screw (not shown) which is turned by means of a wheel 21. The wheel.21 is manually operated so that the feed rate of the workpiece to the cutting tools may be adjusted to different types of tube material and different drive speeds.

Referring now to Figures 2 to 4 there is shown the head 2 of Figure 1 in a variety of further cutting modes.

In Figure 2 the head 2 is adapted to cut small bore tubes. To this end a cutting tool 22 is held in an inverted U member 23 which is secured in the slot 24 in the head 2 by grub screws. By using an inverted U member 23 to secure the cutting tool 24 in the head 2 the cutting tool 24 is brought as close as possible to the centre of the head 2.

In Figure 3 the U member 23 is inverted from its position in Figure 2. In this mode the cutting tool 22 is shifted from its position in Figure 2 by the thickness of the base of the U slot. This makes it suitable for use on boiler tube sizes.

In order that the U member may be used as shown in Figure 1 to support the T member in its vertical position it will be noted that its length is equal to the length of the slot in the head minus the thickness of the base of the T member.

Finally in Figure 4 a T member 25 is shown in its horizontal position. In this position a cutting tool 26 secured in it is moved out still further from the centre of the head 2 than in Figure 3. This mode is suited for use on heavy wall thicknesses and large diameter tubes.

It will be appreciated that in order to meet the requirements of any particular situation the U members and T members may be used in any combination of the modes shown in Figures 1 to 4.

It will further be appreciated that through the use of both T and U members with each profiling tool the smallest possible tube profiling tool may be achieved for a particular application, thus making the profiling tool ideally suited to use in the field and in-situ. In addition because of its small size and lightness the profiling tool may be used in any position.

Finally it will be appreciated that where the profiling tool is to be used exclusively in non-hazardous environments other drive means, e.g. an electric motor may be used.

CLAIMS

1. A tube profiling tool, comprising means for securing the profiling tool relative to a workpiece, a cutting tool support adapted to receive at least one cutting tool, means whereby the cutting tool support and the workpiece may be rotated relative to one another about a predetermined axis, and means whereby the cutting tool support and the workpiece may be moved relative to one another, parallel to said axis, characterised in that the or each cutting tool received by the cutting tool support is secured in position relative to the cutting tool support by an intermediate member which is detachably securable to the cutting tool support, the dimensions of the intermediate member determining the position of the cutting tool relative to the said axis,.

2. A tube profiling tool according to claim 1, characterised in that the cutting tool support comprises a drive head to which the or each intermediate member is detachably secured.

3. A tube profiling tool according to claim 2 characterised in that the drive head is pneumatically driven.

4. A tube profiling tool according to any preceding claim characterised in that the or each intermediate member is detachably secured in a slot in the drive head.

5. A tube profiling tool according to claim 4, characterised in that there are three slots in the drive head.

6. A profiling tool according to any preceding claim characterised in that each intermediate member comprises a slot in which a cutting tool may be engaged.

7. A tube profiling tool according to claim 6 characterised in that the intermediate members comprise U-shaped members which are positioned in the drive head slots so that the cutting tool slot extends parallel therewith, and opens either radially inward or radially outward so as to vary the distance from the said axis of a cutting tool engaged therein by the thickness of the base of the U-shaped member.

8. A tube profiling tool according to claim 6, characterised in that the intermediate members comprise T-shaped members, in which the cutting tool slot extends down into the vertically disposed member to divide the horizontally disposed member, the T-shaped members being positioned in the drive head slots so that the cutting tool slots extend either parallel to or at right angles to the drive head slot.

9. A tube profiling tool according to claim 8 characterised in that in the right angle mode the position of a cutting tool relative to the said axis may be varied according to the length of the cutting tool slot.

10. A tube profiling tool according to claim 7 and claim 8 or 9 characterised in that in the right angle mode a U-shaped member is positioned in the drive head slot behind the T member to provide support.

11. A tube profiling tool according to claim 7 and 8, characterised in that in the parallel mode the distance of a cutting tool from the said axis is greater than the maximum distance of a cutting from the said axis in a U-shaped member.

12. A tube profiling tool according to any one of claims 7 to 11 characterised in that any combination of U and T-shaped members may be used in the drive head slots.

13. A tube profiling tool according to any preceding claim characterised in that the means for securing the profiling tool relative to a workpiece comprises a bore locating fin type chuck.

14. A tube profiling tool according to any preceding claim characterised in that the means whereby the cutting tool support and the workpiece are moved relative to one another, parallel to the said axis comprises a screw.

15. A tube profiling tool substantially as hereinbefore described with reference to the accompanying drawings.

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